Ministry of Natural Resources
Ontario Lyn McLeod Minister

Northwestern Ontario Forest Technology Development Unit

1988/1989 ANNUAL REPORT

INTRODUCTION

The fiscal year 1988/89 was a very active program year for the Northwestern Ontario Forest Technology Development Unit (NWOFTDU). This Annual Report highlights program activities in each of the following areas: technology management, technology transfer, development and demonstration projects and administration. The staff of NWOFTDU have maintained an active presence in many current forestry and integrated resource management issues, hopefully to the benefit of our clients groups and the Ministry at large. These areas of involvement almost always reflect priority 'needs' established through the NWOFTDU's committee structure. The functions of the various advisory, steering, and review committees, are outlined in the NWOFTDU Implementation Strategy (1987).

The objective of this report is to review and report on the status of those approved NWOFTDU's activities outlined in the 1988/89 Work Plan.

PROGRAM

The activities of NWOFTDU can be subdivided into three major programs:

* Technology Management
* Technology Transfer
* Development / Demonstration Projects.

The achievements for 1988/89 for these three programs are outlined below.

TECHNOLOGY MANAGEMENT

One of the greatest impediments to field technology improvement is that information on existing technologies is not being received by field managers on a regular basis. To improve upon this situation, the following four activities were initiated:

a) Literature Reviews and Technical Reports

The objective of literature reviews is to summarize information on pertinent field topics in an easy to read format. Technical reports on the other hand present the results and management implications of independent client trials or NWOFTDU's development projects. A total of 13 literature reviews and technical reports were published in 1988/89.

Literature review topics which were covered included direct seeding of black spruce, pre-commercial thinning of jack pine, and impact of timber management activities on martin and fisher habitat. A listing of published technical reports is attached.

b) Technical Notes

Technical Notes are a practical summary of information and/or guidelines arising from literature reviews or the findings of NWOFTDU development projects. The intent of the Technical Notes series is to provide a summary of critical aspects of operational silviculture and habitat management which can be readily assimilated by the practioner.

During 1988/89, two Technical Notes were produced. The first, TN-01, reviewed the use of shelter seeding for black spruce and jack pine in northwestern Ontario. The second technical note outlines a low water crossing alternative that can be used in northwestern Ontario.

c) Old Forestry Trial Inventory

An inventory of all published and unpublished operational / research trials related to forest management and forestry-wildlife issues (ie. habitat management) conducted by O.M.N.R. districts, regions and its research branch as well as by forest industry clients in Northwestern and North Central regions was initiated. An initial survey (Phase 1) was undertaken to determine the magnitude of the undertaking. Each client group was visited to obtain a listing of all projects which included trial name, description, year of establishment, geographic location, responsible agency, species, sub-activity and documentation evaluation (quality, quantity). Data from Phase 1 was entered into the software dBASE III Plus for data manipulation.

During Phase 2, copies were made of all trials and reports which, during the initial assessment, were considered to be either complete or pertinent. Abstracts of these reports are currently being prepared. A data base on all pertinent and completed reports will be entered on the library software Pro-Cite and will be available for client use during the winter of 1990.

d) Library

In cooperation with the Northern Forest Research Unit of the Ontario Tree Improvement and Forest Biomass Institute (OTIFBI), NWOFTDU jointly operates a library and library computer search facility. This service is available for NWOFTDU's clients and staff, as well as OTIFBI staff.

The computerization of approximately 4,400 abstracts and titles were completed and made available to clients during 1988/89 on Pro-Cite Library Software.

TECHNOLOGY TRANSFER

a) Newsletter

The newsletter "On-Line" was initiated during 1988/89. Three issues were published and distributed to the client groups. The newsletter focuses upon technical news and ideas, and findings arising from the on-going and completed development trials undertaken by various agencies in northwestern Ontario. Reviews of pertinent technical articles and upcoming events compliment feature articles often written by contributing authors. A reader's forum is also included.

b) Workshops

Two workshops were held during 1988/89. Both workshops were organized on a self-sustaining basis with registration fees used to off-set the costs of speaker's expenses, meeting rooms and publishing of the proceedings.

On April 19-20, 1988, a workshop on "Aspects of Planting: Biology and Practice" was held in Thunder Bay. The second workshop, entitled "Aspects of Site Preparation : Biology and Practice" was held in Fort Frances on September 22-24, 1988.

c) Extension Services

Staff specialists at the NWOFTDU are available to assist field clients in solving field problems, concerns or information needs. Examples of subjects of extension requests made during 1988/89 include:

* Vegetation Management (Product Rates, Timing, Non-Chemical Alternatives)
* Competition Index for Assessing Non-Crop Vegetation
* Forest Ecosystem Classification (FEC) Treatment Units
* Pre-Commercial Thinning in Jack Pine
* Free-To-Grow (FTG) Survey Techniques and Statistics
* Experimental Design for Development Trials
* Blowdown and Salvage Harvesting
* Environmental Assessment Information Requests

DEVELOPMENT/DEMONSTRATION PROJECTS

Twelve development/demonstration projects were initiated during 1988/89 with Ministry of Northern Development and Mines funding. The objectives and general project descriptions were outlined in the 1988/89 Work Plan. Project plans providing detailed information on objectives, rationale, methodologies, experimental design, budget, and time lines are on file at the NWOFTDU.

A summary of the status of each project by project number is outlined below:

40) Northwestern Ontario Forest Ecosystem Interpretations

The Northwestern Ontario Forest Ecosystem (NWOFEC) Interpretations guide is a complementary publication to A Field Guide to the Northwestern Ontario Forest Ecosystem Classification and Field Guide to the Common Forest Plants of Northwestern Ontario. This non-scientific document used the NWOFEC as a framework for building forest management interpretations. These interpretations illustrate how the NWOFEC can be used practically to communicate ideas, organize technology and promote good forest management.

Basic interpretations such as erosion risk, site productivity, frost heave hazard and susceptibility to spruce budworm attack are based on soil or vegetation structure in a relatively simple way. Likewise, suggested uses of the NWOFEC for describing wildlife habitat are presented.

The concept of Treatment Units is important to the practical application of the NWOFEC in planning. The treatment unit concept is defined and a set of 16 general and stylized treatment units are proposed for northwestern Ontario. Managers are encouraged to develop their own treatment units and a "how to" section of the manual describes how this is accomplished.

The interpretation guide is intended as a first approximation and will be updated on a regular basis as new information and technology becomes available.

41) Development of a 0 to 5 Year Pre- and Post-Spray Competition Index.

The need for vegetation management on sites being regenerated to conifers is readily recognized by many practising foresters. The presence of non-crop vegetation on a site may affect survival and growth of the conifer by diverting resources of moisture, nutrients and sunlight away from the crop species. In addition, non-crop vegetation may rapidly colonize the available above- and below-ground growing space creating a physical barrier to the establishment and growth of the conifer.

Forest managers need to be able to communicate in an objective, quantifiable and consistent manner, about the degree to which this non-crop vegetation is occupying the site and influencing the growth performance of the crop species. Such assessments are commonly required in determining the need for tending, evaluating the efficacy of a tending treatment, documenting the effectiveness of various regeneration treatments (ie. chemical site preparation), and evaluating Free-to-Grow status. The purpose of this project was to develop a reliable, efficient and easily-applied index for quantifying the levels of non-crop vegetation on a site in relation to status of the crop trees.

The project included a review of competition indices and models for tolerant conifer species from the North American literature and existing assessment procedures for quantifying non-crop vegetation on a site. A competition index was then developed based upon existing assessment procedures and information derived from the literature. The index was then field tested on a number of different site preparation and tending projects which had varying levels of success (qualitative).

Data is collected from circular 4 m^2 plots. Non-crop species which are known competitors with conifers are listed and their average height and percent cover on the plot is recorded. A ratio of crop tree height : competitor height is used to weight the impact of the competing vegetation on the conifer. Data for calculating a competition index can be obtained concurrently with provincial surveys such as first and second year survival assessments, fifth year stocking assessments and Free-to-Grow assessments. The data is also easily collected when performing quality checks on site preparation or planting projects.

The collection of data could be improved by adapting the procedure to incorporate a data collection device. However, a Dbase III Plus program was constructed to receive the raw data from tally sheets, create a project record of the survey, calculate the Competition Index and report same.

The significance of the index is that it quantitatively identifies key competitive species on specific sites. The Competition Index can be easily-applied to pre-tending assessments, used to evaluate post-spray success and provide more useful information for describing Free-to-Grow conditions. The index should prove valuable in providing project-specific documentation related to need for chemical tending.

42) Integrating Wildlife and Forest Management

A 40-minute VHS video and accompanying manual highlights the major issues which must be resolved when resource managers integrate wildlife and timber management. The objective is to stimulate constructive discussions among disciplines in a workshop, seminar or discussion group format.

The video illustrates fundamental principles of wildlife and timber management using footage obtained in northwestern Ontario with supporting material from OMNR archives. It promotes a strong message of mutual cooperation and understanding to attain management objectives.

The instructors manual summarizes, in more detail, some of the issues and problems in integrating wildlife and timber management concerns. A special emphasis is placed on leading questions or topics of discussion which will direct viewers to solve problems for themselves. The major benefits attained from this video will result from the quality of thought provoking discussions raised afterwards.

44) Development of a Pocket Guide to the Critical Silvics of Conifer Crop Species and Selected Competitive Vegetation in Northwestern Ontario.

This project represented a continuation of two literature reviews initiated in 1987/88 respecting critical silvics of both crop- and non-crop vegetation. Although some additional literature was collected and synthesized during 1988/89, it was decided to postpone any further work until sufficient funding could be made available to expand the number of competitive species being studied and assemble all information in a waterproof field manual. In November 1989, NWOFTDU staff were successful in securing a COFRDA direct delivery

research project for $36,000 to complete this work. Completion date is January 1990 with publication expected in June 1990. All literature is being abstracted and entered on the Pro-Cite library database. This will provide a valuable reference for field staff and scientists alike.

45) Development of an Alternative Sampling Design for Collection of Growth and Yield Data Utilizing TRIM Analysis.

Existing tree ring increment measuring systems (TRIM) field sampling methodology requires a complete destructive sample of all stems (living) within a 10 x 10 m plot. This approach is both inefficient and extremely costly and has resulted in a reduction in the use of the TRIM units for practical growth and yield studies. The purpose of this project was to develop an alternative, statistically-valid, two-staged randomized sample design for collection of volume growth data in mature stands and plantations of jack pine and black spruce. Data collected in Northern and North Central Regions was used to analyze the sampling strategies. Trembling aspen was not included due to a lack of suitable data for modelling.

Funding for this project was jointly provided by: Northern Forest Development Group (66 %) and the Northwestern Ontario Forest Technology Development Unit (33 %). The analysis of existing TRIM data and creation of the sampling strategy was contracted to Dr. Gary Murchison, Lakehead University under an agreed upon five-phase contract. Because of administrative delays and problems in transferring the data from Apple IIe to VMS mainframe systems, initiation of this project was delayed; completion of Phase 5 has now been extended until March 31st, 1990.

To date the investigator has successfully developed a sampling strategy for both juvenile and mature jack pine including an approach for those stands where clumping of natural regeneration has occurred. A similar procedure has also been developed for black spruce. A TRIM Sampling Cost Estimator which runs on LOTUS 1-2-3 Version 2.01 has also been completed and is presently being tested by various field staff.

Completion of the report and transfer of the findings to field staff will occur during summer 1990.

46) Shelter Seeding on Highly Productive Sites.

A trial that compared the regeneration treatments of shelter seeding, bare seed and planting current container stock of black spruce and jack pine was established at three locations (Red Lake, Longlac and Manitouwadge) during the spring of 1988. At each location eight replicates of a split plot design were established; four of these replicates will receive tending with Vision during 1990 and the remaining four will serve as a control.

The use of shelter cones resulted in a significant increase in the percent stocking, the number of germinants per seed spot and the height of the initial germinant over bare seed for both jack pine and black spruce. After the first growing season, 82.6% of the jack pine shelter cones were stocked with one or more germinants, whereas the bare seeded plots had only 33.8% stocking over the three sites. Results for black spruce showed a similar trend, but of a different

magnitude; 59.9% of the shelter cone spots were stocked compared to only 10.6% for the bare seeded spots. Out of the four (4) seeds sown per seedling spot, jack pine shelter cones averaged 2.4 germinants compared to 0.5 for bare seed; with black spruce the shelters had an average of 1.4 germinants compared to 0.1 for bare seed. The use of shelter cones significantly increased the initial height of the germinants over bare seed. Differences existed between the sites with results significantly lower in Red Lake. This was attributed to the hot dry conditions in this part of northwestern Ontario during June 1988.

47) Freezer Versus Outdoor Overwinter Storage of Black Spruce Container Stock.

An outplanting trial to compare freezer storage to outdoor overwintering was established during 1988 with black spruce container stock from four private growers in North Central Region, as well as with stock from the Dryden Tree Nursery. Half of the stock was sealed in plastic liners, placed in standard waxed coffin boxes and overwintered in frozen storage during the fall and winter of 1987/88. The other half was overwintered outdoors at the overwintering facilities of the respective private grower or nursery. The stock was outplanted at two sites in Hartington Township of Thunder Bay district. At each site the stock was planted in six replicates in a split plot design with each grower/overwintering treatment represented by 25 tree plots.

Preliminary analysis of first year measurements indicate significant differences amongst growers in terms of survival, current height increment and root collar diameter on both sites. Storage method was not significant for current height increment although there was a significant grower by storage interaction.

48) The Prospects for Improved Overwintering Success of Container Stock in the North Central Region.

Arrival at time of shipping with an unacceptably large proportion of the overwintering container crop damaged has occurred too frequently in the North Central Region. This damage is the result of accumulated stress, both from before and during winter storage. Success can only be ensured by minimizing stress in both periods. The main forms of damage are winter desiccation of the tops and freezing damage of the roots, with winter burn and frost smothering serving secondary roles. By moderating the rate, the depth and the duration of temperature change, low temperature damage can be minimized. Containing the plants and their immediate environment both entraps the inherent moisture level of the crop and excludes the drying influence of moving air.

The attainment of favourable conditions may be accomplished by passive means using principles of thermal mass, insulation, exclusion of sunlight and impermeable envelopment. Active environmental control systems in addition to passive means probably bring about the highest degree of control.

Operational alternatives include : enhanced versions of open holding area method presently in use; the use of structureless covers with or without structured covers; and the use of the cold storage technique which in Ontario is currently used for bareroot stock only.

Cold storage is a good alternative, but it is only practical and cost effective when stock is required to be graded, packaged, and/or kept absolutely dormant until planting. Both structureless covers, and open holding areas with enhanced snow cover offer effective, low cost alternatives worthy of investigation. Structureless covers are somewhat more risky during the early and late winter when conditions could become quite warm causing deacclimation and damage.

The most promising techniques to pursue in the short term appear to be structureless insulating blankets and snow enhancement in open holding areas. In the long term serious consideration should be given to incorporation of the cold storage approach into the container program in order to promote the highest possible likelihood of outplanting success.

49) Aerial Seeding of Jack Pine on Silts and Clays.

A trial was established to document, monitor and evaluate the effectiveness of a spring 1988 operational aerial seeding of jack pine undertaken by Boise Cascade on finer textured soils in the Pakwash Forest. Data was collected during the fall of 1988 from two of the three sites (Paul Road and Lower Overnight Road). Due to early winter conditions, data was not collected from the Mile 23 site and will be undertaken early in the spring of 1989.

50) Usefulness of Landsat Satellite Imagery to Evaluate Deer Habitat.

The NWOFTDU offered partial sponsorship of Bill Darby's doctorate program which is to evaluate the usefulness of Landsat satellite images to evaluate white tailed deer habitat. Funds were made available for data entry and computer analysis. The final report, in the form of a PhD thesis will be completed by September 1989.

Status of the work has been communicated through NWOFTDU's newsletter. We will soon be able to tell if "high tech" predictions have any real meaning for deer.

52) Guidelines for the Early Release and Tending of Spruce Plantations : Literature Review and Proposed Methodology.

The need for release treatments in forest plantations has in the past been determined by experienced personnel based upon visual assessment of the relative growth of competition and crop species. Quantitative assessment of the long-term growth effects of release is important to ensure release programs are achieving silvicultural goals and are cost effective. Post-release assessments are meaningless without pre-release data to compare against, making pre-release assessments an integral part of good forest management.

Methods for assessing the need for release in plantations range from one time measurement, single criteria methods, such as minimum height growth standards for crop species, to competition indices requiring measurements of crop and competition parameters. The main factor influencing tree productivity is stand density but height growth determines to what extent it is being overtopped by the competition; therefore, relative height of crop and competitor is the most important determinant of the need for release in forest plantations. A

competition index based upon relative height of crop and weeds and competitor density is combined with a flow chart to determine the need for release in spruce plantations. The system is quantitative, quick, easy to use and provides a summary of all information needed to make a decision regarding the need for release, treatment to apply and potential future problem species as well as providing a tool to assess treatment efficacy and the need for future treatments.

53) Verification of Black Spruce Site Index Curves and Soil-Site Relationships for Northwestern Region of Ontario.

Black spruce site index curves and soil-site relationships developed for the North Central Region of Ontario were verified in the Northwestern Region. Site index curves in the Northwestern Region were found to be significantly different from those in the North Central Region. Upland and lowland black spruce sites had differently shaped curves.

Soil-site relationships also differed. Black spruce growth was reduced under extremely wet, poorly drained conditions, such as stagnant swamps, and extremely dry, well drained conditions, such as on sites with less than 20 cm of soil. The best growth occurs on moisture retaining silty clays and clay loam soils. A preliminary site productivity key was developed for black spruce in the Northwestern Region.

PROJECTS ADMINISTERED BY NWOFTDU WITH OTHER FUNDING SOURCES

Several other projects were administered during 1988/89 by NWOFTDU using other (non-MNDM) funding sources. These included: the amalgamation of the two regional FEC programs into NWO FEC; a project which examined optimum plantation spacings for boreal species; aerial application of liquid hexazinone on coarse loamy soil as site preparation for conifer plantation establishment; and the preparation of a brochure on the Thunder Bay Spacing Trial. Summaries of these projects are found below.

a) Northwestern Ontario Forest Ecosystem Classification

The Forest Ecosystem Classification programs in Northwestern and North Central Regions were amalgamated in 1988 to produce the Northwestern Ontario Forest Ecosystem Classification (NWO FEC). Amalgamation included combining existing data sets, performing a new analysis, and undertaking a field verification program. The NWOFTDU played a key role in stimulating the amalgamation process.

To meet the marketing needs for combined NWO FEC, field training in the use of NWO FEC was continued throughout both regions, with heavy emphasis placed on changes brought about by amalgamation.

The NWO FEC now describes soils with 13 S-types (deep soils) and 9 SS-types (shallow soils) and vegetation with 38 V-types. Keys to identify the S, SS, and V-types, vegetation and soil factsheets and field data conventions will be described in the Field Guide to the Forest

Ecosystem Classification for Northwestern Ontario. A revised draft is being produced for publication in 1989/90. The field guide will be accompanied by Field Guide to the Common Forest Plants in Northwestern Ontario and Northwestern Ontario Forest Ecosystem Interpretations.

b) What is the Optimum Spacing for Plantation Establishment

This report was undertaken to: 1) determine guidelines for economically optimum establishment spacing regimes and harvest rotations for the major conifer species plantations in various sites in northern Ontario; 2) provide a reference for forestry staff which describes the major components of the analysis; and 3) to provide an overview of research needs, primarily in the growth and yield area.

Included in the review is an outline of basic stand development concepts which provides the reader with an understanding of how forest management strategies (spacing and rotation age) influence stand development and ultimately the production of forest products. In addition to focusing upon spacing or density management, there is also an overview of the economic factors that need to be considered when developing spacing regimes and rotation strategies. The report and software should be available for use in late 1989.

c) Aerial Application of Liquid Hexazinone on Coarse Loamy Soils for Site Preparation

Liquid Hexazinone (Velpar-L) is a soil-active herbicide that provides pre- and post-emergent control of a broad range of annual, biennial, and perennial herbaceous weeds, vines, and woody plants. The label presently allows for spot gun or broadcast application for site preparation treatment prior to planting conifers, and its use is presently restricted on gravelly or rocky soils and soils which are sandy or coarse textured.

The present study was established to test the silvicultural and herbicidal efficacy of Velpar-L as a site preparation treatment on coarse loamy soils. Specific objectives for this trial are:

1. To monitor short- and long term responses of crop trees and competing vegetation as well as shifts in vegetative competition under various treatment rates;

2. To assess conifer tolerance and response when established immediately and one year after Velpar-L application; and

3. To provide data required by Agriculture Canada for the label extension of Velpar-L to coarse loamy soils.

The treatment area is located near Raith on Abitibi-Price Freehold Block 3 on a variable depth, predominantly loamy fine sand. The original stand consisting of 60% jack pine, 20% black spruce, 10% poplar, and 10% white birch was full-tree logged in the winter of 1986. The area was site prepared with Velpar-L in May 1987.

Velpar-L was aerially applied using a helicopter at three rates (1, 2, and 4 kg ai/ha) on

treatment blocks 2 ha in size. All treatments, including controls, were replicated three times for a total of 12 blocks. Each block contains 12 plots of 40 trees, one half planted immediately after treatment, the other half one year later. Three stock types were planted (black spruce bareroot, black spruce container and jack pine container) each year. In addition to crop tree plots, 33 permanent vegetation plots ($5m^2$) were established on each treatment block.

Assessment to determine height, diameter, and health of the crop tree species commenced immediately after planting to provide baseline data for monitoring crop tolerance and response in future assessments. The percent cover, height frequency, and health of all species within the vegetation plots were completed during August, when vegetation development was minimum. Similar field assessments are to be made during 1989 through to 1991.

Parties involved in this project include: Northwestern Ontario Forest Technology Development Unit, Abitibi-Price Inc., and Forestry Canada.

d) Forest Research and Management Demonstration Area: Thunder Bay Spacing Trial

A brochure as well as a self-guiding, interpretive trail was developed through the Thunder Bay Spacing Trial to illustrate the importance of initial spacing on stand development and the difference in growth rates and characteristics of three boreal species, red pine, white spruce, and black spruce. Data on the influence of 1.8, 2.7, and 3.6 meter spacing for the three species was presented for survival, height, diameter at breast height, individual tree volume, and total and merchantable stand volume at ages 16, 25, 32, and 37 years. The productivity of red pine and white spruce at this Thunder Bay site was equivalent to that in southern Ontario (Petawawa) indicating that wood production in northern Ontario can be equal to that in southern Ontario for these two species on these glaciolacustrine, sandy loam sites.

ADMINISTRATION

a) Staffing

The staffing of NWOFTDU was complete with the hiring of Pat Corbett as the Pine Program Forester who began his duties on April 5, 1988. Bill Baker the Black Spruce Program Forester was seconded temporarily to the Environmental Assessment hearings as a witness to prepare and present OMNR's evidence on 'Tree Improvement, Seed Collection and Their Potential Genetic Effects'.

b) Office/Equipment

The Kenora sub-office was established when the Pine Program Forester began in April 1988. Three MS-DOS laptop computers were purchased for the specialists.

c) Budget

Ministry of Northern Development and Mines (MNDM) funding for the 1988/89 work plan was $752.2 M. Expenditures from these funds for the above noted activities amounted to

$764.9 M. Tables 1 summarizes the expenditures by major program or activity. Tables 2 through 4 provide details of expenditures for the core program, technology management, technology transfer and the development/demonstration projects funded by MNDM. Expenditures of the non-MNDM projects are highlighted in Table 5.

TABLE 1. Summary of 1988/89 expenditures ($m) (MNDM funding).

	A*	B**	TCSSE***	TOTAL
CORE (BASE) PROGRAM	240.3	59.3	79 .1	378.7
TECHNOLOGY MANAGEMENT/ TRANSFER		95.2	35.7	130.9
DEVELOPMENT PROJECTS		155.7	99.6	255.3
TOTAL	240.3	310.2	214.4	764.9
(ALLOTMENT)	(275.0)	(210.7)	(266.5)	(752.2)

*Permanent (regular) staff
**Contract (casual) staff
***Transportation, communications, services, supplies & equipment.

TABLE 2. 1988/89 core program expenditures ($m).(MNDM funding)

	A	B	TCSSE	TOTAL
1.SALARIES	240.3	34.3		274.6
EMPLOYEE BENEFITS (CORE PROGRAM)			19.0	19.0
2.TELEPHONE, HYDRO, HEAT			4.1	4.1
3.STAFF TRAINING, WORKSHOPS			6.1	6.1
4.BUILDING MAINTENANCE/ RENOVATIONS			11.3	11.3
5.OFFICE SUPPLIES/COPYING			37.3	37.3
6.COMPUTER ASSISTANCE		25.0		25.0
7.COMMITTEE EXPENSES			1.3	1.3
TOTAL	240.3	59.3	79.1	378.7

TABLE 3. 1988/89 Technology management and transfer program expenditures ($m).

	B	TCSSE	TOTAL
A) TECHNOLOGY MANAGEMENT			
LITERATURE REVIEW	25.3	12.2	37.5
LIBRARY	37.3	2.9	40.2
OLD TRIAL INVENTORY	28.0	7.5	35.5
SUB-TOTAL (ALLOTMENT)	90.6 (94.4)	22.6 (30.5)	113.2 (124.9)
B) TECHNOLOGY TRANSFER			
EXTENSION SERVICES	3.2	10.4	13.6
NEWSLETTER	0.1	0 .6	0.7
WORKSHOPS	1.3	2.1	3.4
SUB-TOTAL (ALLOTMENT)	4.6 (5.3)	13.1 (31.0)	17.7 (36.3)
TOTAL (ALLOTMENT)	95.2 (99.7)	35.7 (61.5)	130.9 (161.2)

TABLE 4.1988/89 Development projects expenditures ($m) (MNDM funding).

PROJ. NO.	PROJECT	B	TCSSE	TOTAL
40	FEC GUIDE	9.6	3.1	12.7
41	POST SPRAY ASSESSMENT	18.6	4.8	23.4
42	WILDLIFE-FORESTRY VIDEO	15.8	45.9	61.7
44	HERBICIDE NOTES	7.8	1.1	8.9
45	TRIM RE-CALIBRATION	-	16.0	16.0
46	SHELTER SEEDING	11.1	6.0	17.1
47	OVERWINTER OF C/S	6.2	1.1	7.3
48	C/S STORAGE OPTIONS	-	3.7	3.7
49	PJ SEEDING ON SILTS & CLAYS	5.7	2.3	8.0
50	DEER HABITAT	10.4	2.6	13.0
52	EARLY RELEASE	5.0	0.5	5.5
53	VERIFICATION SB SITE INDEX	32.0	12.5	44.5
59	FEC AMALGAMATION/FIELD VERIFICATION	33.5	-	33.5
	TOTAL	155.7	99.6	255.3
	(ALLOTMENT)	(97.0)	(126.5)	(223.5)

TABLE 5. Non-MNDM funded projects administered by NWOFTDU, 1988/89.

PROJECT	B	TCSSE	TOTAL	FUNDING SOURCE
A)NORTHWESTERN ONTARIO FEC	86.6	25.3	111.9	COFRDA
B) OPTIMUM SPACING FOR PLANTATION ESTABLISHMENT	4.1	4.0	8.1	ADM NORTH
C) AERIAL APPLICATION OF LIQUID HEXAZINONE	34.9	18.4	53.3	PEST CONTROL / COFRDA
D) THUNDER BAY SPACING TRIAL	6.6	3.6	10.2	COFRDA
TOTAL	132.2	51.3	183.5	

1988/89 Technical Reports Listing

• Prime Land Inventory, Component 2: NOEGST Test study. 1988. Robinson, Merritt and DeVries Ltd. TR#01.

• A pre-cut survey method incorporating the Northwestern Ontario Forest Ecosystem Classification. 1988. W.D. Towill, A. Barauskas and R. Johnston. TR#02.

• Jack pine height and volume growth response to an aerial release treatment using 2,4-D on a plantation near Atikokan, Ontario. 1989. C.S. Krishka and W. D. Towill. TR#06.

• A comparison of crop tree and competing vegetation response to brushsaw release with Vision versus spotgun treatment of Velpar-L. 1988. W.D. Towill, D. Archibald and C.S. Krishka. TR#07.

• Pre-commercial thinning of jack pine. 1988. R. Vassov and W.D. Baker. TR#12.

• Direct seeding of black spruce in northwestern Ontario. 1988. D.J. Archibald and W.D. Baker. TR#13.

• Fisher (Martes pennanti) and timber management in northwestern Ontario: A literature review. 1989. G.D. Racey and B. Hessey. TR#15.

• Martin (Martes americana) and timber management in northwestern Ontario: A literature review. 1989. B. Hessey and G.D. Racey. TR#16.

• A literature review of site preparation and conifer release treatments using 2,4-D, glyphosate or hexazinone herbicides. Part A. Timing of application. 1988. M.E. Carruthers and W.D. Towill. TR#18.

• Stand structure, species competition, and growth of boreal mixedwood forest in northern Ontario: A comparison of natural stands and plantations. 1988. D.M. Morris, M. Rose and G.B. MacDonald. TR#22.

• Evaluation of morphological and physiological response variables of 4-year old black spruce seedlings to perennial competition. 1988. D. Morris. TR#23.

• Site conditions for jack pine seeding. 1989. Z Chrosciewicz. MR#02.

• Aspects of planting: Biology and practice. 1988. Edited by K.M. McClain and A.J. Willcocks. WR#01.